

AD-183 883

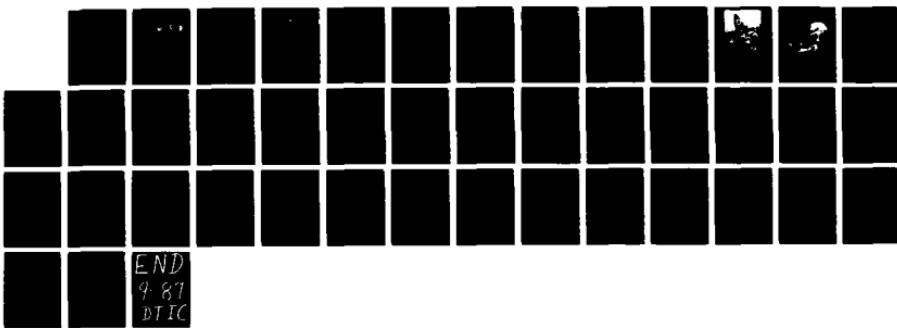
WINGS OF THE FINEST HOUR: EVOLUTION OF THE SUPERMARINE
SPITFIRE(U) AIR COMMAND AND STAFF COLL MAXWELL AFB AL
M W RITZ JUN 87 ACSC-87-2125-A

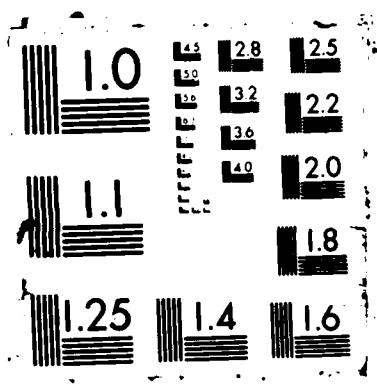
1/1

UNCLASSIFIED

F/G 1/3.3

NL





AD-A183 883

DTIC FILE COPY

2

DTIC
ELECTED
AUG 31 1987
S D
CSD



AIR COMMAND AND STAFF COLLEGE



STUDENT REPORT

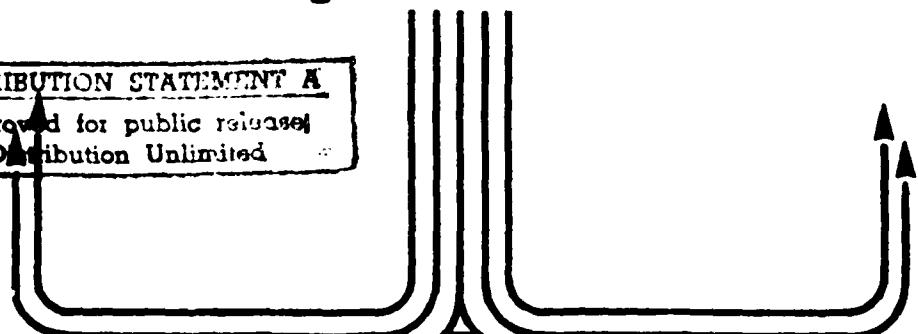
WINGS OF THE FINEST HOUR:
EVOLUTION OF THE SUPERMARINE SPITFIRE

MAJOR MICHAEL W. RITZ 87-2125-A

"insights into tomorrow"

DISTRIBUTION STATEMENT A

Approved for public release
Distribution Unlimited



87 8 23 104

DISCLAIMER

The views and conclusions expressed in this document are those of the author. They are not intended and should not be thought to represent official ideas, attitudes, or policies of any agency of the United States Government. The author has not had special access to official information or ideas and has employed only open-source material available to any writer on this subject.

This document is the property of the United States Government. It is available for distribution to the general public. A loan copy of the document may be obtained from the Air University Interlibrary Loan Service (AUL/LDEX, Maxwell AFB, Alabama, 36112) or the Defense Technical Information Center. Request must include the author's name and complete title of the study.

This document may be reproduced for use in other research reports or educational pursuits contingent upon the following stipulations:

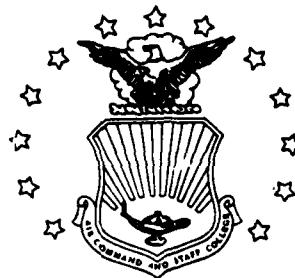
-- Reproduction rights do not extend to any copyrighted material that may be contained in the research report.

-- All reproduced copies must contain the following credit line: "Reprinted by permission of the Air Command and Staff College."

-- All reproduced copies must contain the name(s) of the report's author(s).

-- If format modification is necessary to better serve the user's needs, adjustments may be made to this report--this authorization does not extend to copyrighted information or material. The following statement must accompany the modified document: "Adapted from Air Command and Staff Research Report (number) entitled (title) by (author)."

-- This notice must be included with any reproduced or adapted portions of this document.



REPORT NUMBER 87-2125-A

TITLE WINGS OF THE FINEST HOUR:
EVOLUTION OF THE SUPERMARINE SPITFIRE

AUTHOR(S) MAJOR MICHAEL W. RITZ, USAF/CA ANG

FACULTY ADVISOR MAJOR TOM JAHNKE (ADMINISTRATIVE)

SPONSOR DR. ROBERT M. JOHNSON
DEPARTMENT OF HISTORY (GRADUATE SCHOOL)
UNIVERSITY OF ALABAMA

Submitted to the faculty in partial fulfillment of
requirements for graduation.

AIR COMMAND AND STAFF COLLEGE
AIR UNIVERSITY
MAXWELL AFB, AL 36112

AC 101 0 0 0 0	
NTIS GRA&I	
DTIC TAB	
Unannounced	
Justification	
By	
Distribution	
Availability Code	
Avail Date	
Distr	St

A-1



HD 100-100

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT STATEMENT "A" Approved for public release; Distribution is unlimited.		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE			
4. PERFORMING ORGANIZATION REPORT NUMBER(S) 87-2125-A	5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION ACSC/EDCC	6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State, and ZIP Code) Maxwell AFB AL 36112-5542	7b. ADDRESS (City, State, and ZIP Code)		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. PROJECT NO. TASK NO. WORK UNIT ACCESSION NO.		

11. TITLE (Include Security Classification) WINGS OF THE FINEST HOUR: EVOLUTION OF THE SUPERMARINE SPITFIRE			
12. PERSONAL AUTHOR(S) Ritz, Michael W., Major, USAF/CA ANG			
13a. TYPE OF REPORT	13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (Year, Month, Day) 1987 June	15. PAGE COUNT 34
16. SUPPLEMENTARY NOTATION			

17. COSATI CODES FIELD GROUP SUB-GROUP	18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		

19. ABSTRACT (Continue on reverse if necessary and identify by block number) The evolution of the Supermarine Spitfire is a classic example of the myth and magic of modern combat aircraft development and employment. This research paper examines the Supermarine Spitfire's place in aviation history, including a review of the Spitfire's concept and birth, its technological evolution, and its combat evolution. In examining the Spitfire's concept and birth, the paper discusses designer R. J. Mitchell, the doctrine, strategy, and perceptions of the RAF, and the British aircraft industry. A review of the Spitfire's technological evolution includes a brief examination of airframe, armament, and performance characteristics. The aircraft's combat evolution concludes the paper, discussing the Spitfire's combat performance in the Battle of Britain and successive World War II campaigns and comparing the Spitfire with other contemporary fighter aircraft. Notes and bibliography are included.		
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL ACSC/EDCC Maxwell AFB AL 36112-5542		22b. TELEPHONE (Include Area Code) (205) 293-2483
		22c. OFFICE SYMBOL

ABOUT THE AUTHOR

Major Michael W. Ritz is chief of public affairs for the 146th Tactical Airlift Wing, California Air National Guard. A member of the Air National Guard since 1968, he served with the 146TAW in the enlisted ranks, in the audiovisual and public affairs career fields, until receiving his commission in 1977. Major Ritz was public affairs officer for the 162nd Combat Communications Group and 129th Aerospace Rescue & Recovery Group, respectively, before returning to the 146TAW in 1981. During his military career, Major Ritz has performed numerous short overseas tours with the Air Force and Air National Guard in Central and South America, Southeast Asia, Asia, the Pacific, Europe, and the Mediterranean. Domestic assignments include active participation in joint and combined combat exercises with a variety of Air Force and Air National Guard units. Presently attending Air Command & Staff College, he is a resident graduate of Squadron Officer School, the Reserve Forces Course, Defense Information School, and the Air Force Short Course in Communication. He is an active member of several professional organizations including the National Guard Associations of the United States and California, the Air Force Association, and the Military Order of the World Wars. In his civilian endeavors, Major Ritz is a freelance writer-photographer with extensive creative and technical experience in the motion picture and television industries. He received his Bachelor of Arts degree in Drama from California State University, Northridge in 1971 and is currently earning his Master of Arts degree in Military History from the University of Alabama.

**Wings of the Finest Hour:
Evolution of the Supermarine Spitfire**

Major Michael W. Ritz
Air Command & Staff College, Class of 1987
B. A., California State University, Northridge

Directed Research Paper

Submitted in partial satisfaction of
the requirements for the degree of
Master of History
at
University of Alabama
History of Air Power
Dr. Johnson
Montgomery, Alabama
June 1987

Table of Contents

Preface.....	iii
Illustrations.....	iv

Wings of the Finest Hour

The Myth and the Magic.....	1
Of Seagulls and Seaplanes.....	4
Riding the Edge of the Sky.....	10
The Testing Ground.....	14
An Aeroplane for the Ages.....	21
Endnotes.....	23
Bibliography.....	30

What General Weygand called the Battle of France is over. I expect that the Battle of Britain is about to begin. Upon this battle depends the survival of Christian civilisation. Upon it depends our own British life, and the long continuity of our institutions and our Empire. The whole fury and might of the enemy must very soon be turned on us. Hitler knows that he will have to break us in this island or lose the war. If we can stand up to him, all Europe may be free and the life of the world may move forward into broad, sunlit uplands. But if we fail, then the whole world, including the United States, including all that we have known and cared for, will sink into the abyss of a new dark age made more sinister, and perhaps more protracted, by the lights of perverted science. Let us therefore brace ourselves to our duties, and so bear ourselves that, if the British Empire and its Commonwealth last for a thousand years, men will still say, "This was their finest hour."

- Sir Winston Churchill addressing the House of Commons and a nationwide radio broadcast audience, June 18, 1940. From American Heritage Magazine and United Press International, eds., Churchill's The Life Triumphant, biographical essay by Henry Anatole Grunwald, (New York: American Heritage Publishing Co., Inc., 1965), p. 91.

Illustrations

Plate 1--Supermarine Spitfire Mk II.....	v
Plate 2--Battle of Britain.....	vi
Memorial Flight	



Plate 1--Mk II Supermarine Spitfire, P7350, banks sharply to the left as it performs aerobatic maneuvers for the camera. Part of the Battle of Britain Memorial Flight, this Spitfire exemplifies the exceptionally clean aerodynamic lines found in aircraft designer R. J. Mitchell's masterpiece. Powered by an 1175 horsepower Rolls-Royce Merlin XII engine, this Spitfire is capable of flying at better than 360 miles per hour in level flight. (Photo courtesy RAF)

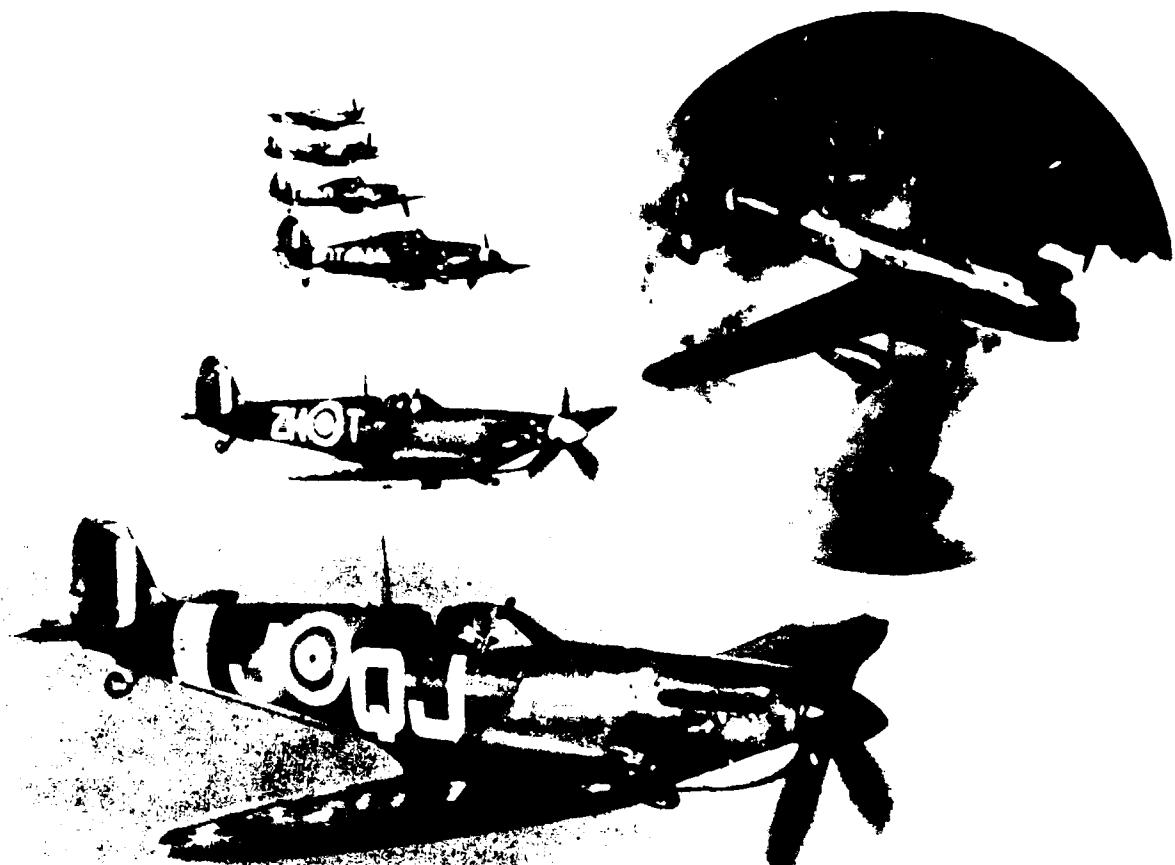


Plate 2--The Battle of Britain Memorial Flight in formation. In tribute to the Battle of Britain - and to the Supermarine Spitfire and Hawker Hurricane - the flight was formed at Biggin Hill aerodrome in 1957. In the foreground are two Spitfires, Mk V AB 910 (JQJ) and Mk II P 1350 (ZKOT). In the background are two Hawker Hurricanes and two additional Spitfires. The inset photo is a four-engined Lancaster bomber, FA 474, which joined the flight in November 1973. (Photo courtesy RAF)

**Wings of the Finest Hour:
Evolution of the Supermarine Spitfire**

by Major Michael W. Ritz

The Myth and the Magic

In the summer months of August and September 1940, the bombers and fighters of Germany's Luftwaffe were matched against the fighters of Britain's Royal Air Force in what is known as the Battle of Britain. It was the epitome of violent aerial combat; the ultimate testing ground for pilot and aircraft. It was the German Luftwaffe's strategy of offensive strategic bombing - preceding Operation Sea Lion (Germany's planned invasion of England), against the defensive strategy of Britain's Fighter Command - supporting the survival of its homeland. In the clouds above London, and over the villages, farms, estates, and airfields of southern and central England, a nimble fighter aircraft could be seen and heard. It was an aerodynamic masterpiece that soared over the English countryside and into history. Its name was Spitfire.¹

On August 20, 1940, following several days of exceptionally intense air battles between British and German aircraft in the skies over southern and central England, Prime Minister Winston Churchill spoke to the House of Commons and the British people:

The gratitude of every home in our Island, in our Empire, and indeed throughout the world, except in the abodes of the guilty, goes out to the British airmen who, undaunted by odds, unwearied in their constant challenge and mortal danger, are turning the tide of the World War by their prowess and their devotion. Never in the field of human conflict was so much owed by so many to so few.²

Churchill was paying tribute to Fighter Command and those pilots who blunted the Luftwaffe's best and proven the once- invincible German Air Force vulnerable to British aerial skill and fighter aircraft technology. Among the "few" that Churchill praised were pilots flying the Supermarine Spitfire.

The Spitfire and the Hawker Hurricane were the workhorses of Fighter Command during the Battle of Britain. It would be the Spitfire, however, that would come to symbolize the efforts of England against Germany in the Battle of Britain. Developed in the mid-1930's, the Spitfire quickly gained the awe and admiration of both friendly and enemy pilots.³

In his book, Battle of Britain: The Hardest Day, 18 August 1940, Alfred Price relates the thoughts of Luftwaffe

Messerschmitt Bf 109 fighter pilot, Hans-Otto Lessing, in a letter by Lessing dated August 17, 1940:

During the last few days the British have been getting weaker, though individuals continue to fight well. Often the Spitfires give beautiful displays of aerobatics. Recently I had to watch in admiration as one of them played a game with 30 Messerschmitts, without itself ever getting into danger; but such individuals are few. The Hurricanes are tired old "puffers."⁴

Another recollection is that of Jeffrey Quill, Spitfire test pilot and one who flew the Spitfire from its earliest days to its retirement from active RAF service in the late 1950's. Quill writes:

The Battle of Britain was a very public affair, fought mainly over southern England in full view of the people, who at once felt a sense of personal involvement. That the Spitfire and the Hurricane became absorbed into the folklore of Britain is therefore neither surprising nor inappropriate. Certainly it was in 1940 that the little Spitfires, so easily recognisable in the air, suddenly captured the imagination of the British people and became a symbol of hope and of victory. Later, in 1941, 1942, and 1943, the sound of the Spitfires sweeping daily over northern France, Belgium, and the Netherlands, challenging

the enemy to come up and fight, brought the hope of victory and liberation to the people of those occupied countries.⁵

What was this airplane that captured the imagination of the British people and symbolized hope and victory? How well did it really perform in the Battle of Britain and in other theatres of World War II aerial combat? What made it such a dangerous and deadly opponent? The evolution of the Supermarine Spitfire is a classic example of the myth and magic of modern combat aircraft development and employment. Acknowledging the Spitfire's place in aviation history requires a brief examination of its myth and magic, including a review of its concept and birth, its technological evolution, and its combat evolution.

Of Seagulls and Seaplanes

The concept and birth of the Supermarine Spitfire was a masterful blend of three factors. First, and most dominant, was the Spitfire's designer, Reginald Joseph Mitchell. The second factor was the Royal Air Force, including its airpower doctrine and strategy from the late 1920's to mid-1930's and the threat it perceived from the growing German Luftwaffe. The British aircraft industry, in particular, the competition between the Vickers Aviation Ltd. and Hawker Aviation Ltd. aircraft companies and the development of high performance aircraft engines by

Rolls-Royce Ltd., was the third factor influencing the concept and birth of the Spitfire.

Beginning in 1925, R. J. Mitchell designed and developed several successive revolutionary seaplane racers for Supermarine Aviation Works, Ltd. Aviation technology was changing rapidly in the 1920's, especially aircraft design and construction and aircraft powerplant engineering. Metal skin was replacing fabric on aircraft fuselage and wing surfaces, and internal frame structures were strengthened. Engines were made smaller and lighter, yet much more powerful. Speed, range, and maneuverability increased as designers found answers to their imaginative and innovative ideas. In the late 1920's, England, Italy, and the United States were acknowledged leaders in aviation technology, dominating specialized aircraft races and testing the limits of both man and machine. Symbolic of aviation's technological preeminence during that period was the Schneider Trophy. While competing for the Schneider Trophy, and for the world speed record, Mitchell conceptualized and developed the basic designs and technology that would evolve into the Supermarine Spitfire. In 1927, England won the Schneider Trophy with the winning aircraft averaging 281.65 miles per hour. Shortly after the race, the contestants decided to compete every other year rather than annually because of cost and design considerations.⁶

Mitchell continued to modify and expand on his design and development of single-wing, high-speed racing seaplanes after Vickers-Armstrong (Vickers Aviation Ltd.) purchased Supermarine

in 1928. With few exceptions, the great majority of all other racing and military aircraft of the late 1920's were biplane designs. By the summer of 1929, Mitchell had designed and built the Supermarine S.6, a seaplane racer powered by a supercharged, 1,850 horsepower, Rolls-Royce V-12 "R" engine. His racer defeated the Italians in the 1929 Schneider Trophy race, averaging 328.63 miles per hour. Mitchell's marriage of his Supermarine racer with a Rolls-Royce engine was the beginning of a exceptionally advantageous and mutually beneficial association. Winning the Schneider Trophy three times in succession meant permanent possession for the winner. For England, a third consecutive win meant symbolic mastery of the air. A more powerful engine had to be developed if England was to win an unprecedeted third Schneider Trophy and maintain its dominance in aviation racing.⁷

In the summer of 1931, Mitchell's Supermarine S.6 aircraft evolved into the Supermarine S.6B, powered by a 2,350 horsepower Rolls-Royce "R" engine variant. The aircraft was, in actuality, a very early prototype of the first Supermarine Spitfire. On September 13, 1931, flying against no other competition but itself, Mitchell's Supermarine S.6B won for England permanent possession of the prestigious Schneider Trophy by racing the Schneider Trophy course at an average speed of 340.08 miles per hour. Mitchell's aircraft was now the fastest in the world.⁸

Later that same month, the Schneider champion Supermarine S.6B, flown by Flight Lieutenant George H. Stainforth, became the first aircraft to fly faster than 400 miles per hour, setting a

world air speed record of 407.5 miles per hour. Mitchell's S.6B racing seaplane, revolutionary in both design and performance, set the standard for state-of-the-art racing aircraft during the early 1930's. The creation, design, and production of Mitchell's Supermarine Spitfire fighter aircraft was not far behind.⁹

In 1930, the Air Ministry issued specification F.7/30, calling for a high-performance fighter aircraft meeting state-of-the-art standards for armament, speed, range, and maneuverability. Following the success of his S.6B seaplane, Mitchell undertook the design of a fighter aircraft capable of meeting the specifications outlined in F.7/30. In March 1932, his design was accepted by the Air Ministry and a Supermarine (Vickers Aviation Ltd.) prototype was ordered built.¹⁰

Mitchell's Spitfire prototype, the Supermarine Spitfire Type 224, was built and test flown in 1933 and early 1934. Powered by a Rolls-Royce Goshawk engine, the prototype was a gullwinged monoplane with fixed undercarriage. During this same period, Mitchell fell gravely ill with cancer. Following major surgery, he took time to convalesce by visiting the European continent. He toured Germany and discovered first-hand the potential threat of the Luftwaffe. The Spitfire prototype failed to meet the Air Ministry's F.7/30 standards and Mitchell was determined more-than-ever to develop a fighter aircraft that met and exceeded the Air Ministry's standards and, at the same time, countered the all-too-real threat from the German Luftwaffe. By the end of 1934, Mitchell had designed an entirely new prototype. Vickers Aviation Ltd. began construction on a new Spitfire

variant, the Supermarine Type 300, in January 1935. Its development came none-too-soon. In March 1935, Adolph Hitler and Reichsmarchall, Hermann Goering, officially unveiled the German Luftwaffe to the world. The potential threat had finally come to life.¹¹

Between 1928 and 1934, the Royal Air Force concerned itself with a defensive doctrine and strategy for the use of airpower. Because Germany was forbidden by the Versailles Treaty from having an air force, the only other potential enemy of any concern to the British in the very early 1930's was France. However, by 1934, intelligence from Germany exposed the rapid development of a secret German air force: the Luftwaffe. During this same period, RAF tactical flying exercises developed fighter-interceptor tactics designed to protect the home islands from enemy bomber and fighter attack. These basic tactics of fighter-interceptor force integration would later be used during the Battle of Britain on a much larger, and much more complex scale. Because fighter aircraft were the mainstay of this doctrine and strategy, the British Air Ministry decided the RAF would need the best possible fighter aircraft technology to defend England. Though technology would drive the Air Ministry's needs, considerable difference of opinion between monoplane and biplane designs still existed in the Air Ministry. One example of this difference of opinion was the Air Ministry's ordering production of the Gloster Gladiator biplane in July 1935. Merging R. J. Mitchell's prototypical Spitfire design with the Air Ministry's fighter aircraft specifications would crystalize

under the influence of the British aircraft industry.¹²

Vickers Aviation Ltd. and Hawker Aviation Ltd. aircraft companies were vigorous and aggressive competitors for a superior, state-of-the-art, British fighter aircraft. R. J. Mitchell's counterpart at Hawker Aviation Ltd. was Sidney Camm. Both Mitchell and Camm concerned themselves with monoplane designs they hoped would revolutionize both the military and civilian aircraft industries. The Hawker Hurricane, designed by Camm, was a counterpart to the Supermarine (Vickers) Spitfire. Competition between Vickers and Hawker to develop the most effective and dominant fighter, according to Air Ministry specifications, created an atmosphere of technical ingenuity. Ironically, each aircraft would complement the other during the coming war years.¹³

Developed and tested during the same approximate time period as the Spitfire, the Hurricane was manufactured by Hawker Aviation Ltd. using as much readily available technology and tooling as possible. In contrast, Mitchell and Supermarine developed new technology and tooling, requiring more time for problem-solving and flight testing. Powerplant, fuselage, and wing modifications (changing wing shape from a tapered to an elliptical configuration) caused production delays for the Spitfire. Engine development and reconfiguration caused initial production delays for the Hurricane. Both Vickers and Hawker realized their aircraft needed superior powerplants. Rolls-Royce Ltd. provided the aircraft engine that powered Mitchell's S.6B Supermarine seaplane racer to win the Schneider Trophy.

Rolls-Royce was now tasked with developing a powerplant for state-of-the-art fighter aircraft. Because the engines would be the same for both Hurricane and Spitfire, engine maintenance would be simplified in RAF squadrons fielding either aircraft. Supply of replacement parts from the manufacturer would also be made easier. By the end of 1935, the Rolls-Royce Merlin engine was considered ready for installation. The Hurricane would be the first aircraft off the production line while the Spitfire continued to evolve through several months of alterations to engine and wings. These changes, however, would prove invaluable in greatly increasing the performance characteristics of the Spitfire relative to those of other fighter aircraft, including the Hawker Hurricane.¹⁴

R. J. Mitchell's revolutionary prototype design, the potential fighter aircraft needs of the RAF as outlined by the British Air Ministry, and the competition between Vickers Aviation Ltd. and Hawker Aviation Ltd. aircraft companies had been instrumental in the concept and birth of the Supermarine Spitfire. Between 1935 and 1939, the technological evolution of the Spitfire continued as changing RAF requirements and rigorous flight testing brought out the strengths and weaknesses of the aircraft.

Riding the Edge of the Sky

The most important fighter aircraft requirements for the RAF

were found in guns, speed, range, and maneuverability. On March 6, 1936, R. J. Mitchell and a small host of Vickers-Supermarine and Air Ministry dignitaries, as well as several friends and co-workers, watched aircraft K5054, the Supermarine Spitfire Type 300, take wing with test pilot, J. "Mutt" Summers, at the controls. For Summers, and the observers below, the Spitfire immediately showed its ability in both speed and maneuverability. According to Jeffrey Quill, "Certainly to those of us watching from the ground "the Fighter" in the air took on a very thoroughbred and elegant appearance, a strong but indefinable characteristic which was to remain with it throughout its long, varied and brilliantly successful life as a fighting aeroplane." With the Luftwaffe building its strength in Germany, the Spitfire's first taste of battle would not be long in coming.

Testing the K5054 began in earnest.¹⁵

On February 26, 1936, the British Cabinet developed Scheme F proposing the order of 600 Hawker Hurricanes and 310 Supermarine Spitfires. On June 3, 1936, the Air Ministry instituted Scheme F by officially signing the order. The Spitfires had been ordered even though many test flights had yet to be completed. In light of the growing threat from the German Luftwaffe, the Air Ministry was, for the most part, considering production of the Spitfire on its potential as a fighter aircraft, rather than on its proven ability.¹⁶

Throughout 1936 and into the early months of 1937, considerable testing was done using the K5054 Spitfire airframe. The Air Ministry required an armament of eight Browning .303

machine guns, four in each wing. The Spitfire's elliptical wing configuration, redesigned by Mitchell from a tapered wing configuration in 1935, was well-suited for the armament requirement. The Hawker Hurricane carried the same armament. The K5054 also went through refinement of its Rolls-Royce Merlin engine, as well as reconfiguration of its propeller blades. These refinements continued to increase the performance characteristics of the Spitfire, including its maximum level speed, combat turning radius, time to height capability, and overall fuel consumption.¹⁷

R. J. Mitchell died on June 11, 1937. He was forty-two years old. Although Mitchell did not live to see his effort roll off the production line, he did see his beloved Spitfire fly. Mitchell realized his dream of designing one of the world's great fighter aircraft and saw that his accomplishment would, indeed, become a reality.¹⁸

More refinements were added to the K5054 airframe and by September 1937, the Spitfire looked and flew like a formidable fighter aircraft. Gun-heating and gun-jamming were continuing problems that would not satisfactorily be solved until October 1938. Perhaps the greatest problem was in actual production of the Spitfire. Labor problems, tooling difficulties, subcontracting slowdowns, and bickering between the government and the manufacturer continued to be factors in the Spitfire's production slow-down. The Hurricane suffered little from these woes, although continued engine refinements would eventually force a slow-down in its production. In the spring of 1938, the

first Mk I Spitfires began coming off the assembly lines of Vickers Aviation Ltd. The first production Spitfire entered squadron service on August 4, 1938. When politics and technology finally balanced, the on-time production of the Spitfire was back on course by March 1939.¹⁹

The Supermarine Spitfire would continue to evolve as each was test flown before delivery to an active unit. Constant testing and refining of the Spitfire would lead to rapid improvement, especially in the heat of the coming wartime situation. By August 1939, less than one month before the start of World War II, the Spitfire was already building a reputation as a great aircraft. Designer and engineer, Joe Smith, filled the vacuum at Supermarine left by the death of R. J. Mitchell. Smith appreciated Mitchell's design and realized the growth potential of the Spitfire. When politics threatened the end of Spitfire production in early 1939, Smith countered with further evolution of the Spitfire by initiating development of Mk II and Mk III versions. Smith's decision effectively stopped the moves to end Spitfire production and signaled the beginning of the Spitfire's entry into rapid combat evolution.²⁰

The Supermarine Spitfire weathered the tests of experimental development, the death of its creator, and the politics of technological survival. The original requirements of the Air Ministry and the RAF were met and exceeded with the production of the first Spitfire. The constant test flying added to the Spitfire's technological evolution and helped prepare the fighter for its greatest challenge: the test of combat evolution.

Examining the combat evolution of the Supermarine Spitfire includes its comparison with both enemy opposition and its friendly counterpart, the Hawker Hurricane, as well as a brief review of the Spitfire's performance in aerial combat.

The Testing Ground

The Battle of Britain provided a near-perfect combat testing ground for the Supermarine Spitfire. Both the Spitfire and its friendly alter ego, the Hawker Hurricane, were pitted against the German Luftwaffe's best, including the Messerschmitt Bf 109E and Me 110 fighters, and the Heinkel 111H, Dornier 17, and Junkers Ju 88 twin-engined bombers. Beginning in June 1940, and continuing through September of that same year, the Battle of Britain raged in the skies and over the ground of central and southern England. The battle was most ferocious during the months of August and September, with both sides suffering high aircraft and aircrew attrition.²¹

The Battle of Britain Hawker Hurricane was slightly larger than its brother-in-combat Supermarine Spitfire. Both aircraft carried eight Browning .303 machine guns and both aircraft used Rolls-Royce Merlin engines, or follow-on variants of the Merlin engine. An early weakness for both aircraft was the lack of fuel-injection for the Rolls-Royce engines. When either aircraft performed negative gravity combat maneuvers, the engine tended to stall or quit due to lack of fuel in the carburetor. A clear

edge in beauty, speed, and maneuverability went to the Spitfire. The Hurricane proved a bit more rugged, in part, because of its fuselage's fabric over metal tube construction, rather than metal skin over metal tube construction found on the Spitfire. Enemy rounds tended to shatter and splinter when striking the Spitfire's fuselage, while the same rounds would pass through the Hurricane's fabric-covered fuselage. Both aircraft had metal covered wings. But the Spitfire's disadvantage in ruggedness was offset by its combat performance characteristics.²²

Because of the Spitfire's greater speed and maneuverability, and the Hurricane's heavier armor, the British developed the tactic of having their Spitfires concentrate on attacking German fighter escorts and the Hurricanes concentrate on attacking incoming bombers. The Spitfire's primary adversary, the Messerschmitt Bf 109E, compared quite well to the Spitfire relative to flying characteristics. Both aircraft could take off very quickly. Faster than the Bf 109E, the Spitfire was able, for the most part, to turn inside its opponent, even though the Bf 109E had a tighter turning circle. With its speed advantage, the Spitfire could outrun the Messerschmitt. The constant-speed propeller - standard on the Messerschmitt - was added to the Spitfire in the weeks between late June through mid-August 1940. The prop unit was originally designed and developed by the British, but its advantages were not realized until the Battle of Britain. Adding the prop to the Spitfire - as well as the Hurricanes - transformed the performance of the aircraft. The Bf 109E had an advantage in being fuel-injected. Later variants of

the Rolls-Royce engine, installed in both the Hurricane and Spitfire, would nullify this advantage. Armor plate was added to Spitfire and Hurricane seat backs while German fighter aircraft lacked armor seat backs throughout most of the Battle of Britain. The Bf 109E's armament consisted of two 7.92mm machine guns firing from the top of aircraft's engine cowling through the aircraft's prop, and two 20mm cannon, one on each wing of the aircraft. The Spitfire's eight Browning .303 machine guns proved more than a match. Visibility was the unquestioned advantage of the Spitfire. It's bubble-shaped canopy gave the pilot an outstanding peripheral view. The Messerschmitt, on the other hand, provided its pilot with a very narrow, restricted angle of view. In dogfights, this advantage would prove disastrous to more than a few German pilots.²³

The combat evolution of the Spitfire Mk I - including the development and employment of follow-on variants (Mk IA through Seafire 47) during and following the Battle of Britain - was due, for the most part, to the experiences and suggested improvements of combat and test pilots who flew the aircraft in a variety of combat theatres. In his book, Spitfire Pilot, Flight Lieutenant D. M. Crook says:

Actually, once you have done a few hours flying in a Spitfire and become accustomed to the great power and speed, then it is an extraordinarily easy machine to fly and it is absolutely marvelous for aerobatics. Practically everybody who has flown a Spitfire thinks

it is the most marvelous aircraft ever built, and I am no exception to the general rule. I grew to like it more than any other machine I have flown. It is so small and compact and neat, yet is possesses devastating fire power, and it is still probably the best and fastest fighter in the world. The new fighters which will be coming into service will have to do very well to equal the Spitfire's amazing record of success.²⁴

Other pilots seemed equally fascinated with the Spitfire, even those pilots who later flew the Hurricane. Such pilots could offer backhanded praise of the Spitfire, while at the same time, offer criticism that would be used in improving follow-on Spitfire variants. According to Battle of Britain ace, Wing Commander R. R. Stanford Tuck:

My reaction to my first flight in the Hurricane after the Spits was not good. She seemed like a flying brick, a great lumbering stallion. It nearly broke my heart because things seemed tough enough without trying to tackle Me 110's in a great heavy kite like this. But after the first few minutes I found the Hurricane's virtues. She was solid and it was obvious she'd take a devil of a lot of punishment. She was steady as a rock, and was a wonderful gun platform. The visibility was far better than in the Spit. The undercart was stronger and wider and that

made landing a lot easier. Somehow she gave the pilot terrific confidence. You felt entirely safe in this plane.²⁵

The criticism Tuck made of the Spitfire's canopy view is debatable. However, later versions of the Spitfire would use a more highly-evolved bubble-shaped canopy that provided the pilot much greater angle of peripheral view. The undercarriage, another weakness of the Spitfire, would be strengthened following the Battle of Britain. The Spitfire would evolve as their pilots and missions evolved and each variant improved as engine and airframe improved. Over time, Rolls-Royce modified and redesigned their powerplants from the original 1035 horsepower Merlin II engine found on the Mk I and IA Spitfires, to the staggering 2350 horsepower Griffon 88 engines found on the Mk FR 47 Seafires. A Mk I Spitfire, equipped with a Merlin II engine, had a top speed of approximately 362 miles per hour. A Mk FR 47 Seafire, powered by the Griffon 88 engine, could sustain level speeds of better than 450 miles per hour. In dives from high altitude, Spitfires - even early Mk I's - were known to approach and exceed an indicated airspeed of 600 miles per hour. The Spitfire's armament moved from the original eight Browning .303 machine guns, to a mix of machine guns and 20mm cannon, and on to the firepower of four 20mm cannon and a load of 1000 pounds of bombs or rockets. The Spitfire proved to be a very menacing opponent in virtually any theatre of aerial conflict to which it was committed.²⁶

According to retired Flight Lieutenant Kenneth Pugh, the Spitfire's flexibility was used effectively in close support of ground forces in Palestine during World War II:

After three months the squadron move to El Bassa just inside Palestine on the Syrian border. We kept our Hurricanes until January 1944 when, to our delight, we converted to the clipped-wing Spitfire V at Megiddo, about forty miles from El Bassa. Our role now changed to low level work, never more than six thousand feet and generally under three thousand. We worked closely with the Army, spotting enemy ground targets for the artillery.²⁷

Squadron Leader Paul Day, RAF Battle of Britain Memorial Flight Training Officer, believes the Spitfire remains one of the finest high-performance fighter aircraft ever built. Day, an F-4C pilot, has flown several Mk variants of the Spitfire. In his *Wingspan* article, "The Pilot's Spitfire-2: A Novice's Viewpoint," Day says:

The Spitfire, like Georgian silver or a best London gun, is one of those few artefacts which one knows to be instinctively "right", and that knowledge in no way relies upon the professional expertise of the beholder. That may explain the Spit's continuing to be held in a special awe, almost reverance, by generations to whom the

emotional attachments cannot apply. At its most base it is, undoubtedly, the second finest collection of geometric curves ever assembled and, at best, one of the few examples of something which exceeds its aura and mystique in every way.²⁸

Fifty-two variants of the Spitfire were produced following production of the first Mk I Spitfire in 1938. These variants were used in a variety of aerial combat roles including fighter-interceptor, fighter-bomber, and ground attack. The Spitfire was seen in the skies over the Mediterranean and North Africa. It challenged the air and ground forces of Germany in Europe and attacked German V-1 missiles fired against England in 1944 and early 1945. It flew over the Holy Lands in the Middle East. In the Seafire Mk FR 47 variant, the Spitfire served England from the deck of an aircraft carrier.²⁹

Most of the Spitfire's pilots had made special note of the aircraft's speed and agility. From those who flew the original Mk I to those who experienced the incredible horsepower of the later Rolls-Royce Griffon-engined masterpieces, speed and agility had been the hallmark of their love affair with the Spitfire. Americans who flew Spitfires in the Battle of Britain's Eagle Squadron would later apply their combat flying skills to American fighter aircraft when the United States entered the war. Adolph Galland, leading Luftwaffe ace and a pilot who faced Spitfires behind the controls of his Bf 109E and Me 262 jet fighter, was also most impressed and remarked frequently on the exceptional

combat characteristics of the Spitfire. The same can be said for other German pilots who faced the elliptically-winged fighter and lived to tell the story. The aircraft had endeared itself to both friend and foe. By the end of World War II, the Spitfire was the only Allied fighter to have been in full production, and served on front-line service, from the beginning to the end of the war. Its aerodynamic lines and powerful engine greatly influenced the development of one of the United States' most outstanding World War II fighters, the P-51 Mustang. With the advent of jet engines, the Supermarine Spitfire proved to be a key technological bridge between piston and jet engine fighter aircraft.³⁰

An Aeroplane for the Ages

Today, the Spitfire continues to fly as an honored member of England's Battle of Britain Memorial Flight. It flies, in part, as a tribute to those brave "few" who fought and died in the Battle of Britain, and throughout World War II. It also flies to remind England's general public of the importance of air defense. In that way, the Spitfire's legendary past remains an aviation legend for the present and the future.³¹

Examining the concept and birth of the Supermarine Spitfire and reviewing its technological and combat evolution shows this British fighter to be a classic example of the myth and magic of modern combat aircraft development and employment. It is a

fighter aircraft for the ages, a superb machine that dominated the skies and influenced military aviation for many generations. In the words of Jeffrey Quill:

The Spitfire was very much a pilot's aeroplane. It had an indefinable quality of excitement about it - an unmistakable charisma - which greatly appealed to young and eager pilots, added to which it was the fastest and highest performance fighter of its day and most pilots wanted to fly the best. 32

In this age of supersonic jet aircraft it might be hard to imagine the sound of a finely tuned and very powerful Rolls-Royce piston engine turning the prop of a keenly designed Supermarine Spitfire. Yet imagination can bring back the sound and the sight. The myth and magic of the Spitfire will always be with those who look up toward the clouds and picture the elliptical wings and clean aerodynamic lines of one of the greatest fighting aircraft in history.

Notes

¹The Rise and Fall of the German Air Force: 1933-1945, introduction by Air Commodore H. A. Probert, first published in 1948 in Great Britain by the Air Ministry, (New York: St. Martin's Press, 1983), pp. 75-88. Excellent discussion of the Luftwaffe's strategy and tactics when opposing such British fighters as the Supermarine Spitfire. Affords the reader an excellent analysis as to why the Germans failed to seize the initiative and defeat Fighter Command during the Battle of Britain. See also B. H. Liddell Hart, History of the Second World War, (New York: Perigee Books, 1982), pp. 87-98; and Abraham Rothberg, Eyewitness History of World War II, Vol. 2: Siege, (New York: Bantam Books, 1962), pp. 12-13 and 18-19.

²Rothberg, p. 13.

³Ralph Barker, The RAF at War, The Epic of Flight Series, (Alexandria, Virginia: Time-Life Books, 1981), p. 46. Good general overview of the RAF's participation in World War II. The book provides information on the Spitfire's operational use during and following the Battle of Britain. It also contains discussion on the doctrine and strategy of the Royal Air Force before and during World War II. A brief comparison between the Spitfire and the Hurricane is also presented.

⁴Alfred Price, Battle of Britain: The Hardest Day, 18

August 1940, (New York: Charles Scribner's Sons, 1979), p. xv.

Price's book is an excellent description of one day's combat in the Battle of Britain. It contains superb information on the operation and performance characteristics of all Battle of Britain combative aircraft. Personal descriptions of aerial combat tactics, as well as recollections on other aspects of aerial warfare, written by British and German participants, are seen throughout. The material presented by Price is especially useful when reviewing the Spitfire's combat performance and evolution in relation to other British aircraft and enemy aircraft.

⁵Jeffrey Quill, Spitfire, (London: Arrow Books Limited, 1985), p. 289. Fine source material for information on the concept, development, and employment of the Supermarine Spitfire and its variants. Detailed facts on flight performance and characteristics, weapon systems, combat operations, and engine development are valuable for analyzing the Spitfire mystique. Quill's book, while highly supportive of the Spitfire, relates information regarding the Spitfire's British rival, the Hawker Hurricane, as well as such German aircraft as the Messerschmitt Bf 109 and Focke-Wulf Fw 190. Spitfire examines the full range of the aircraft's history, including concept and birth, and technological and combat evolution.

⁶Paul O'Neil, Barnstormers & Speed Kings, The Epic of Flight Series, (Alexandria, Virginia: Time-Life Books, 1981), pp.

90-99. The author provides extensive background information on R. J. Mitchell's accomplishments prior to Mitchell's design of the Spitfire fighter aircraft. Of special interest is material related to the Supermarine S.6B, the ancestor of the Supermarine Spitfire.

⁷O'Neil, pp. 94-99; and Enzo Angelucci, The Rand McNally Encyclopedia of Military Aircraft, translated from the Italian by S. M. Harris, originally published in Italian in 1980 by Arnoldo Mondadori Editore S. p. A., Milano, Italy under the title Atlante Enciclopedico degli Aerei Militari del Mondo dal 1914 a oggi, (New York: The Military Press, 1983), p. 218. Angelucci's work is a masterpiece of technological comparison and contrast. His data on the Spitfire includes scaled drawings of several Mk variants.

⁸O'Neil, p. 98-99; Philip J. R. Moyes, "Spitfire I and II," Wingspan, March/April 1986, No. 31, p. 21; Angelucci, p. 218; and Quill, pp. 12-13. Moyes appears to have taken much of his information from Jeffrey Quill's book, Spitfire.

⁹O'Neil, p. 99; and Quill, pp. 12-13.

¹⁰Len Deighton, Fighter: The True Story of the Battle of Britain, (London: Triad/Panther Books, 1979), pp. 94-95. This is a fine book detailing the background of the Battle of Britain, including a wealth of information on the concept, design, production, and performance of the Supermarine Spitfire. The book also provides information comparing the Spitfire to the Hawker

Hurricane, as well as comparative descriptions of German Luftwaffe fighter aircraft. See also Quill, pp. 12-13 and 60-61.

¹¹Deighton, pp. 95-97; Quill, pp. 78 and 95; Moyes, pp. 24-25; and The Rise and Fall of the German Air Force: 1933-1945, p. 11.

¹²Deighton, pp. 56-58 and 95-97; Quill, pp. 12-15 and 28-31; and Barker, pp. 6 and 19-20.

¹³Deighton, pp. 83-86 and 97; and Quill, pp. 79-80.

¹⁴Deighton, pp. 78-80 and 98-99; Quill, p. 88; and Angelucci, pp. 217-218.

¹⁵Quill, p. 71-72. Jeffrey Quill disputes the date of the Spitfire K5054's first test flight. Moyes, p. 25; and Deighton, p. 97, use March 5, 1936 as their frame of reference.

¹⁶Quill, pp. 84-85; Moyes, p. 25; and Angelucci, p. 218.

¹⁷Deighton, pp. 98-99; Moyes, p. 25; and Quill, pp. 79-84. Quill's work contains extensive technical references to the K5054's flight characteristics. As one of the Spitfire's primary test pilots, he writes from a first-hand perspective.

¹⁸Quill, p. 95; and Deighton, p. 99.

¹⁹Quill, pp. 114-120; Deighton, p. 98; and Moyes, p. 25.

²⁰Quill, pp. 120-122 and 132-137.

²¹Leonard Mosley, The Battle of Britain, World War II Series, (Alexandria, Virginia: Time-Life Books, 1977), pp. 46-57. This book is an excellent general reference on the Battle of Britain. Mosley provides insight into the background, initiation, and execution of the air battle. Included in the text is information regarding the performance characteristics of the Supermarine Spitfire relative to the Hawker Hurricane, as well as its enemy opposition. Additional detailed information on various aspects of the Battle of Britain is found in Len Deighton's Fighter, Jeffrey Quill's Spitfire, Ralph Barker's RAF at War, and Alfred Price's Battle of Britain: The Hardest Day. Each of these books provides valuable source information for those interested in further topic research.

²²Mosley, pp. 52-53; Deighton, pp. 80-105; Quill, pp. 174-176; Price, pp. 20-22; Moyes, pp. 25-27; and Angelucci, pp. 217-219. Angelucci provides an excellent cutaway drawing of a Spitfire Mk VB on pp. 168-169 of his book. Details of the aircraft's components, including location of internal structures, powerplant, and armaments are shown.

²³Deighton, pp. 86-93, 99-101, and 103-107; Mosley, pp. 52-55 and 86-89; Moyes, p. 26; and Price, p. 21.

²⁴D. M. Crook, Spitfire Pilot, (London: Faber and Faber Ltd., 1942), p. 20. Crook's book provides a very intimate view of the Spitfire's combat performance during the Battle of Britain. The writing is from a combat pilot's perspective and the text contains references not only to the Spitfire's obvious

strengths, but to its weaknesses, as well. Crook also provides anecdotal information on the Hawker Hurricane's combat performance.

²⁵R. R. Stanford Tuck as quoted in Paul Gallico, The Hurricane Story, (London: Michael Joseph, 1959), p. 81. Gallico's book provides the reader a biased look at the Spitfire's friendly competitor, the Hawker Hurricane. Tuck's quote is one of only a very few mentions of the Spitfire's existence by Gallico.

²⁶Moyes, pp. 26-27; Crook, pp. 80-81; "Spitfire Supreme: The Spitfire Numbers," Wingspan, March/April 1986, No. 31, pp. 18-19; Kenneth Pugh, "The Pilot's Spitfire-1: Low Level in a Spit," Wingspan, March/April 1986, No. 31, pp. 27-31; and Paul Day, "The Pilot's Spitfire-2: A Novice's Viewpoint," Wingspan, March/April 1986, No. 31, pp. 32-33. Pugh and Day offer two perspectives as respective past and present Supermarine Spitfire pilots. Pugh flew the Spitfire in several theatres of combat during World War II. Day is an active pilot in the Royal Air Force with more than 4300 total flying hours.

²⁷Pugh, p. 29.

²⁸Day, p. 32.

²⁹Quill, pp. 154-176, 180-182, and 187-205; Moyes, pp. 26-27; and "Spitfire Supreme: The Spitfire Numbers," pp. 18-21. Quill's discussion of evolutionary developments in the Spitfire's performance capability, during and following the Battle of

Britain, is exceptionally detailed. Quill provides outstanding data regarding the changing technology of the Spitfire variants. In "Spitfire Supreme: The Spitfire Numbers," we are given a valuable listing of existing Spitfire aircraft numbers and their locations.

³⁰Quill, pp. 212-241, 252-256, and 278-287; Mosley, pp. 56-57; Crook, pp. 80-83; and Angelucci, p. 218.

³¹Tim Laming, "RAF History - In the Air," Royal Force Yearbook 1986, London: Ducimus Books Ltd., p. 35.

³²Quill, p. 289.

Bibliography

Books

Angelucci, Enzo. The Rand McNally Encyclopedia of Military Aircraft. Translated from the Italian by S. M. Harris. Originally published in Italian in 1980 by Arnoldo Mondadori Editore S. p. A., Milano, Italy under the title Atlante Enciclopedico degli Aerei Militari del Mondo dal 1914 a oggi. New York: The Military Press, 1983.

Barker, Ralph. The RAF at War. The Epic of Flight Series. Alexandria, Virginia: Time-Life Books, 1981.

Crook, D. M. Spitfire Pilot. London: Faber and Faber Limited, 1942.

Deighton, Len. Fighter: The True Story of the Battle of Britain. London: Triad/Panther Books, 1979.

Gallico, Paul. The Hurricane Story. London: Michael Joseph, 1959.

Liddell Hart, B. H. History of the Second World War. New York: Perigee Books (G. P. Putnam's Sons), 1982.

Mosley, Leonard. The Battle of Britain. World War II Series. Alexandria, Virginia: Time-Life Books, 1977.

O'Neil, Paul. Barnstormers & Speed Kings. The Epic of Flight Series. Alexandria, Virginia: Time-Life Books, 1981.

Price, Alfred. Battle of Britain: The Hardest Day, 18 August

1940. New York: Charles Scribner's Sons, 1979.

Quill, Jeffrey. Spitfire: A Test Pilot's Story. London: Arrow Books Limited, 1985.

The Rise and Fall of the German Air Force: 1933-1945.

Introduction by Air Commodore H. A. Probert. First published in 1948 in Great Britain by the Air Ministry.

New York: St. Martin's Press, 1983.

Rothberg, Abraham. Eyewitness History of World War II. Vol. 2: Siege. New York: Bantam Books, 1962.

Periodicals

Day, Paul. "The Pilot's Spitfire-2: A Novice's Viewpoint." Wingspan, March/April 1986, No. 31, pp. 31-33.

Laming, Tim. "RAF History - In the Air." Royal Air Force Yearbook 1986. London: Ducimus Books Ltd. pp. 35-41.

Moyes, Philip J. R. "Spitfire I and II." Wingspan, March/April 1986, No. 31, pp. 21-27.

Pugh, Kenneth. "The Pilot's Spitfire-1: Low Level in a Spit." Wingspan, March/April 1986, No. 31, pp. 27-31.

"Spitfire Supreme: The Spitfire Numbers." Wingspan, March/April 1986, No. 31, pp. 18-21.

END

9-87

DTIC